Catalogue of American Amphibians and Reptiles.

EASTEAL, SIMON 1986. *Bufo marinus.*

Bufo marinus (Linnaeus)
Giant toad

Rana marina Linnaeus, 1758:211. Type-locality, "America." Holotype not located.
Bufo brasiliensis Laurenti, 1768:26. Type-locality and type specimen not designated.
Rana gigas Wallbaum, 1784:239. Smith et al., 1977
Bufo Marinus: Schneider, 1799:219.
Bufo agua Latreille, 1801:130. Type-locality Brazil and Cuba.
Bufo horridus Daudin, 1802:63. Type-locality not given. Type whereabouts unknown.
Bufo humeralis Daudin, 1803:205. Type-locality. "Cayenne," syntypes (2) in collection of "Madame Bonaparte" and (1) in "le museum d'histoire naturelle," the last collected by J. Martin; present status of types unknown.
Bombinator horridus: Merrem, 1820:179.
Bufo maculiventris Spix, 1824:43. Type-locality, "in sylvis et aquis palodosis ad ripam fluminis Solimoens," Brazil. Syntypes, whereabouts unknown.
Bufo lazarus Spix, 1824:45. Type-locality, "Amazonfluss."
Bufo horribilis Wiegmann, 1833:654. Type-locality, "in der Umgegend von Vera Cruze" Mexico; restricted to "Veracruz, Veracruz, Mexico," by Taylor, 1952a:800. Syntypes, Mus. Naturkunde, Berlin, West Germany, 3478-81 (not examined by author).
Docidophryne agua: Fitzinger, 1843:32.
Bufo molitor Tschudi, 1845:169. Type-locality, "in Republica Peruana," no type specimen designated.
Docidophryne Lazarus: Fitzinger, 1861:415.
Phrynoidis agua: Cope, 1862:358.
Bufo andianus Cope, 1868:115. Type-locality, "valley of Quito," Ecuador, and "Carthagena, New Grenada [Colombia]." Syntypes, U.S. Nat. Mus. 4350(1), 6112(3); specimens lost.
Bufo pithecodactylus Werner, 1899:481. Type-locality, "La Union," Colombia. Holotype, adult female.
B[ufo] marinus agua: Gadow, 1901:178.
Bufo marinus marinus: Schmidt, 1932:159.
Bufo marinus andinensis Melin, 1941:14. Type-locality, "Roque, Peru, collected by the natives." Syntypes, 1 male, 3 females, no catalogue numbers or repository stated (not examined by author).
Bufo angustipes Taylor and Smith, 1945:553. Type-locality, "La Esperanza, Chiapas," Mexico. Holotype, adult female, U.S. Nat. Mus. Natur. Hist. 116513, collected by Dr. and Mrs. Hobart M. Smith, 7 April 1940 (not examined by author).
Bufo marinus horribilis: Shannon and Werler, 1955:368.

● CONTENT. No subspecies are recognized. See COMMENT.

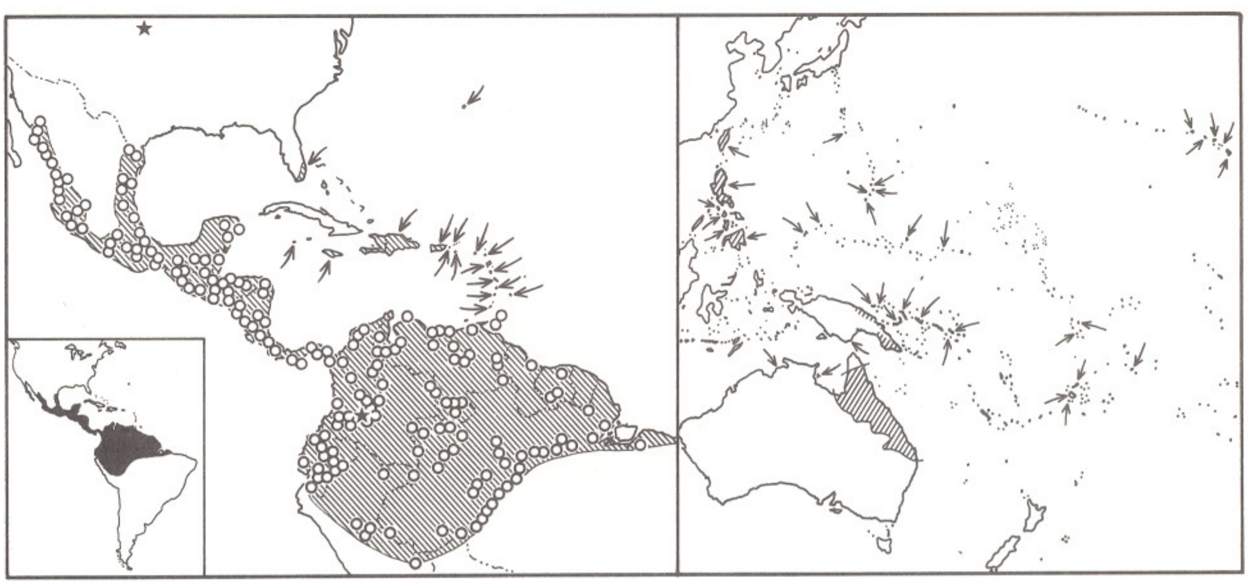
● DEFINITION. *Bufo marinus* is a large toad; females can weigh over 1.5 kg and attain snout–vent lengths greater than 225 mm and generally are larger than males. Most adults range in size from 85 to 150 mm. The parotoid glands are large relative to other species and often triangular and swollen in appearance. Their shape has been used to distinguish *B. marinus* from its close relatives in South America. Cranial ridges are well developed. The skin of both sexes is covered with irregularly scattered warts. In sexually active males each wart bears one or more horny spicules. The dorsum of females and immature males has irregular blotches of various shades of brown, whereas adult males are a more uniform yellow-brown color, the yellow being pronounced laterally and around the throat. The mating call is a low pitched trill (Blair, 1956).

● DESCRIPTIONS. The eggs are described by Sein (1937) and the tadpoles by Ruthven (1919), Kenny (1969) and Duellman (1978). Descriptions of adults are in Cochran and Goin (1970), Duellman (1978), Inger (1954) and Taylor (1952b).

● ILLUSTRATIONS. For drawings of eggs and tadpoles, see Breder (1946) and Kenny (1969). A color photograph of spawn in the field is in Barker and Grigg (1977). Color photographs of adults are found in Blair (1972) (female), and Barker and Grigg (1977) (male). Among many published black and white photographs are those in Honegger (1970, female), Duellman (1978, male), and Reed and Borowsky (1966, amplexing pair).

● DISTRIBUTION. Natural populations of *Bufo marinus* occur continuously from extreme southern Texas and northwestern Mexico to central Brazil (Cei, 1968, 1972; and Zug and Zug, 1979). Upper altitudinal limits vary with latitude, from 1600 m in Venezuela, to 500 m in Sinaloa, Mexico (Zug and Zug, 1979). Introductions have spread *B. marinus* widely in the Caribbean and Pacific regions. Easteal (1981) and Honegger (1970) describe the history of introductions and map the distribution of exotic populations. Sabath et al. (1981) and Easteal et al. (1985) and Easteal and Floyd (1986) describe its distribution and spread in Australia.

● FOSSIL RECORD. Two fossils exist. One from the late Miocene La Venta fauna of the upper Magdelana Valley, Huila, Colombia (Estes and Wassersug, 1963), is the oldest known fossil *Bufo* from South America. The other is from a Lower Pliocene assemblage from Trego County, Kansas, well outside the species present distribution (Wilson, 1968).



MAPS. Left, native distribution in the Western Hemisphere (shaded area with circles indicating specific localities), introduced populations (arrows) and Miocene and Pliocene fossil sites (stars). Right, areas in the Pacific region where populations are introduced and established (arrows and shading).

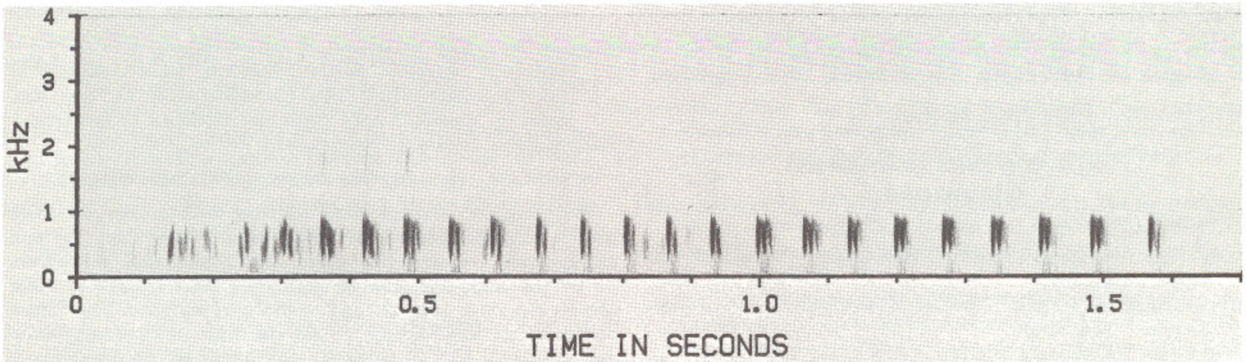


FIGURE. Audiospectrogram of an advertisement call of *Bufo marinus*: Tinalandia, Pichinchah Prov., Ecuador, 27 Apr. 1978; body 26°C; AMNH Dept. Herpetology tape 221, 45 Hz filter, specimen AMNH 102774.

● PERTINENT LITERATURE. The enormous literature of *B. marinus* can only be sampled here. *Genetics:* Volpe and Gebhardt (1968), Straus (1971), Schmid (1978), Sabath (1981), Harding and Catterall (1983), Easteal (1985a, b). *Anatomy:* Martin del Campo (1934), Tenney and Tenney (1970), Roth (1973), Hostetler and Cannon (1974). *Physiology* I. *General:* Luque et al. (1961), Martinez-Albelo and Liburd (1963), Hutchison et al. (1968), Boyd and Goodyear (1971), Diener and Marchalonis (1970), Goldfischer et al. (1970), Hutchison and Kohl (1971), Nicoll and Licht (1971). II. *Temperature and water:* Stuart (1951), Thorson (1964), Warburg (1965), Heatwole et al. (1968), Brattstrom (1968), Heatwole and Newby (1972), Shoemaker and Waring (1968), Machin (1969), Krakauer (1970), Valerio (1971), Johnson (1972), Bretag et al. (1980), Sherman (1980), Floyd (1983). *Biochemical and clinical aspects of toxic secretions:* Allen and Neill (1956), Barbier et al. (1959), Peneyra and Masanga (1966), Licht (1967), Kamano et al. (1968), Licht and Low (1968), Chen and Osuch (1969), Osuch and Chen (1969), Croce and Bolognani (1972), Low (1972). *Behavior:* Brattstrom (1962), Rand and Rand (1966), Williams (1967), Loftus-Hills and Johnstone (1969), Boice and Boice (1970), Greding (1971), Fite (1973), Jaeger (1977), Ingle and McKinley (1978), Saxena and Lal (1981), Rossi (1983). *Natural history and general ecology:* Straughan (1966), Krakauer (1968), Zug et al. (1975), Zug and Zug (1979), Zug (1983), Floyd and Benbow (1984). *Growth, development and longevity:* Pemberton (1934, 1949), Sein (1937), Ely (1944), Zipser et al. (1969), Durant (1974). *Breeding and reproduction:* Stuart (1935), Breder (1946), Kenny (1969), Duellman (1978). *Predators and parasites:* Lehmann (1966), Marinkelle (1970), Kloss (1974), Covacevich and Archer (1975), Zug et al. (1975), Brooks (1976), Carpenter and Gillingham (1984). *Economic importance:* Volkenberg (1935), Wolcott (1937, 1950), Marinkelle and Willems (1964), Kourany et al. (1970), Tyler (1976).

● ETYMOLOGY. *Marinus* is the Latin word for "of the sea." Linnaeus described *B. marinus* from a drawing in Seba (1734), who mistakenly believed that the species "*terra marique vivere patet*" (is free to live on land and in the sea).

COMMENT

Taylor and Smith (1945) believed that *B. marinus* was "of almost generic significance" and revived the name *horribilis* Wiegmann "for most of the toads of this group in México." Many subsequent papers used *B. horribilis* for Mexican *B. marinus.* It was not stated, however, how these differed from *B. marinus.* Duellman (1961) noted that, because no systematic study of *B. marinus* exists, recognition of separate species or subspecies is meaningless and Taylor and Smith's revival of *B. horribilis* should be rejected. *B. arenarum, B. ictericus, B. paracnemis, B. rufus* and *B. poeppigi* have at one time been treated as subspecies of *B. marinus.* They are distinguishable mainly on the basis of differences in body size, coloration, and shape and size of parotoid and tibial glands (Bertini and Cei, 1962; Lutz, 1934; Lutz and Kloss, 1952; Cochran, 1954).

LITERATURE CITED

Allen, E. Ross, and Wilfred T. Neill. 1956. Effect of marine toad toxins on Man. Herpetologica 12(2):150–151.

Barbier, M., H. Schoter, K. Meyer, and O. Schinder. 1959. Die Bufogenine des Paratoidensekretes von *Bufo marinus* (L.) Schneider. Helv. Chim. Acta 42:2486–2505.

Barker, J., and G. Grigg. 1977. A field guide to Australian frogs. Rigby, Adelaide. 229 p.

Bertini, F., and J. M. Cei. 1962. Seroprotein patterns in the *Bufo marinus* complex. Herpetologica 17(4):231–238.

Blair, W. Frank. 1956. Call difference as an isolation mechanism in southwestern toads (genus *Bufo*). Texas J. Sci. 8(1):87–106.

——— (ed.). 1972. Evolution in the genus *Bufo.* Univ. Texas Press, Austin. viii + 459 p.

Boice, R., and C. Boice. 1970. Interspecific competition in captive *Bufo marinus* and *Bufo americanus* toads. J. Biol. Psychol. 21(1):32–36.

Boyd, Claude E., and C. P. Goodyear. 1971. Somatic and gametic dry matter and protein in gravid females of several amphibian species. Comp. Biochem. Physiol. 40A:771–775.

Brattstrom, Bayard H. 1962. Homing in the giant toad, *Bufo marinus.* Herpetologica 18(3):176–180.

——— 1968. Thermal acclimation in anuran amphibians as a function of latitude and altitude. Comp. Biochem. Physiol. 24(1):93–111.

Breder, Charles M. 1946. Amphibians and reptiles of the Rio Chucunaque drainage, Darien, Panama, with notes on their life histories and habits. Bull. Amer. Mus. Natur. Hist. 86(8): 375–436.

Bretag, A. H., S. R. Dawe, and A. G. Moskwa. 1980. Chemically induced myotonia in Amphibia. Nature 286:625–626.

Brooks, D. R. 1976. Five species of Platyhelminths from *Bufo marinus* L. (Anura: Bufonidae) in Colombia with descriptions of *Creptotrema lynchi* sp. n. (Digenea: Allocreadiidae) and *Glypthelmins robustus* sp. n. (Digenea: Macroderoididae). J. Parasitol. 62:429–433.

Carpenter, Charles C., and J. C. Gillingham. 1984. Giant centipede (*Scolopendra alternans*) attacks marine toad (*Bufo marinus*). Caribbean J. Sci. 20(1–2):71–72.

Cei, Jose M. 1968. Remarks on the geographical distribution and phyletic trends of South American toads. Pearce-Sellards Ser. Texas Mem. Mus. 13:3–21.

——— 1972. *Bufo* of South America, p. 82–101. *In* W. Frank Blair (ed.), Evolution in the Genus *Bufo.* Univ. Texas Press, Austin. viii + 459 p.

Chen, C., and M. V. Osuch. 1969. Biosynthesis of bufadienolides-3-hydroxycholanates as precursors in *Bufo marinus* bufadienolides synthesis. Biochem. Pharmacol. 18:1797–1802.

Cochran, Doris M. 1954. Frogs of southeastern Brazil. U.S. Nat. Mus. Bull. (206):xvi + 423 p.

———, and C. J. Goin. 1970. Frogs of Colombia. U.S. Nat. Mus. Bull. (288):xii + 655 p.

Cope, Edward D. 1862. Catalogues of the reptiles obtained during the explorations of the Parana, Paraguay, Vermejo and Uraguay (sic) rivers, by Capt. Thos. J. Page, U.S.N.; and of those procured by Lieut. N. Michler, U.S. Top. Eng., Commander of the expedition conducting the survey of the Atrato River. Proc. Acad. Natur. Sci. Philadelphia 14(9):346–359.

——— 1868. An examination of the Reptilia and Batrachia obtained by the Orton expedition fo Equador and the upper Amazon, with notes on other species. Ibid. 20:96–140.

Covacevich, J., and M. Archer. 1975. The distribution of the cane toad, *Bufo marinus*, in Australia and its effects on indigenous vertebrates. Mem. Queensland Mus. 17(2):305–310.

Croce, G., and L. Bolognani. 1972. Enzyme activities in the skin "venom" of Amphibia. Boll. Zool. 39:313–320.

Daudin, Francois M. 1802. Histoire naturelle des rainettes, des grenouilles et des crapauds. Imprimerie de Bertrandet; libraire Leurault, Paris. 108 p.

——— 1803. Histoire naturelle, generale et particulaire des reptiles, vol. 8. F. Dufart, Paris. 439 p.

Diener, E., and J. Marchalonis. 1970. Cellular and humoral aspects of the primary immune response of the toad, *Bufo marinus*. Immunology 18:279–293.

Duellman, William E. 1961. The amphibians and reptiles of Michoacán, México. Univ. Kansas Publ. Mus. Natur. Hist. 15(1): 1–148.

——— 1978. The biology of an equatorial herpetofauna in Amazonian Ecuador. Univ. Kansas Mus. Natur. Hist. Misc. Publ. (65):1–352.

Durant, P. 1974. Factors which affect the development of two species of tropical tadpoles. Soc. Venezolana Cienc. Natur. 128:21–32.

Easteal, Simon. 1981. The history of introductions of *Bufo marinus* (Amphibia:Anura); a natural experiment in evolution. Biol. J. Linn. Soc. 16:93–113.

——— 1985a. The ecological genetics of introduced populations of the giant toad (*Bufo marinus*). II. Effective population size. Genetics 110:107–122.

——— 1985b. The ecological genetics of introduced populations of the giant toad, *Bufo marinus*. III. Geographical patterns of variation. Evolution 39(5):1065–1075.

———, and R. B. Floyd. 1986. The ecological genetics of introduced populations of the giant toad, *Bufo marinus*. Dispersal and neighborhood size. Biol. J. Linn. Soc. 27:17–45.

———, E. K. van Beurden, R. B. Floyd, and M. D. Sabath. 1985. Continuing geographical spread of *Bufo marinus* in Australia: Range expansion between 1974 and 1980. J. Herpetol. 19(2):185–188.

Ely, C. A. 1944. Development of *Bufo marinus* larvae in dilute sea water. Copeia 1944(4):256.

Estes, Richard, and Richard Wassersug. 1963. A Miocene toad from Colombia, South America. Brevoria (193):1–13.

Fite, K. V. 1973. The visual fields of the frog and the toad: a comparative study. Behav. Biol. 9(6):707–718.

Fitzinger, Leopold J. F. J. 1843. Systema reptilium. Fasc. I: Ambyglossae. Braumuller and Seidel, Vienna. 106 + vi p.

——— 1861. Die Ausbeute der österreichische Naturforscher an Säugethieren und Reptilien während der Weltumsegelung Sr. Majestät Fregatte Novara. Sitzungsber. Akad. Wiss. Wien 42(25):383–416.

Floyd, R. B. 1983. Ontogenetic change in the temperature tolerance of larval *Bufo marinus* (Anura:Bufonidae). Comp. Biochem. Physiol. 75A:267–271.

———, and K. F. Benbow. 1984. Nocturnal activity of a population of cane toads. Koolewong 13(1):12–14.

Gadow, Hans. 1901. Amphibia and reptiles, vol. 8, p. xi + 668. *In* S. F. Harmer and A. E. Shipley (eds.), The Cambridge natural history. Macmillan and Co., London.

Goldfischer, S., B. Schiller, and I. Sternlieb. 1970. Copper in hepatocyte lysosomes of the toad *Bufo marinus* L. Nature 228:172–173.

Greding, Edward J. 1971. Comparative rates of learning in frogs (Ranidae) and toads (Bufonidae). Caribbean J. Sci. 11:203–208.

Harding, R., and C. P. Catterall. 1983. Small-scale patterns of variation at the sorbitol dehydrogenase locus in an introduced toad, *Bufo marinus* (Amphibia: Anura). Australian J. Zool. 31:913–923.

Heatwole, Harold, S. B. de Austin, and R. Herrero. 1968. Heat tolerances of tadpoles of two species of tropical anurans. Comp. Biochem. Physiol. 27(3):807–815.

———, and R. C. Newby. 1972. Interaction of internal rhythm and loss of body water in influencing activity levels of amphibians. Herpetologica 28:156–162.

Honegger, R. E. 1970. Eine Krote erobert die Welt. Natur und Mus. 100(10):447–453.

Hostetler, J. R., and M. S. Cannon. 1974. The anatomy of the parotoid gland in Bufonidae with some histochemical findings. 1. *Bufo marinus*. J. Morphol. 142:224–240.

Hutchison, Victor H., and M. A. Kohl. 1971. The effect of photoperiod on daily rhythms of oxygen consumption in the tropical toad, *Bufo marinus*. Z. Vergl. Physiol. 75:367–382.

———, W. G. Whitford and M. Kohl. 1968. Relation of body size and surface area to gas exchange in anurans. Physiol. Zool. 41(1):65–85.

Inger, Robert F. 1954. Systematics and zoogeography of Philippine Amphibia. Fieldiana: Zool. 33(4):183–531.

Ingle, D., and D. McKinley. 1978. Effects of stimulus configuration on elicited prey catching by the marine toad (*Bufo marinus*). Anim. Behav. 26:885–891.

Jaeger, Robert G. 1977. A possible prey-call window in anuran auditory perception. Copeia 1976(4):833–834.

Johnson, C. R. 1972. Thermal relations and daily variation in the thermal tolerance in *Bufo marinus*. J. Herpetol. 6(1):35–38.

Kamano, Y., H. Yamamoto, K. Hatayama, Y. Tanaka, M. Shinokara, and M. Komatsu. 1968. The isolation and structure of new bufadienolide; resibufagin and the isolation of marinobufagin. Tetra. Letts. 54:5669–5672.

Kenny, Julian S. 1969. The Amphibia of Trinidad. Studies Fauna Curacao Caribbean Isl. 29(108):1–78.

Kloss, G. R. 1974. Rhabdias (Nematoda:Rhabditoidea) from the *marinus* group of *Bufo*. A study of sibling species. Arq. Zool. 25:61–120.

Kourany, M., C. W. Myers, and C. R. Schneider. 1970. Panamanian amphibians and reptiles as carriers of *Salmonella*. Amer. J. Trop. Med. Hygiene 19(4):632–638.

Krakauer, Thomas. 1968. The ecology of the neotropical toad, *Bufo marinus*, in south Florida. Herpetologica 24(3):214–221.

——— 1970. Tolerance limits of the toad, *Bufo marinus*, in south Florida. Comp. Biochem. Physiol. 33(1):15–16.

Latreille, Pierre A. 1801. *In* C. S. Sonnini and P. A. Latreille, Histoire naturelle des reptiles, avec figures dessinees d'apres nature. Deterville, Paris. vol. 2. 332 p.

Laurenti, Joseph N. 1768. Specimen medicum exhibens synopsin reptilium emendatam cum experimentis circa venena et antidota reptilium Austriacorum. Joan. Thom., Vienna. 214 p.

Lehmann, D. L. 1966. Two blood parasites of Peruvian Amphibia. J. Parasitol. 52(3):613.

Licht, Lawrence E. 1967. Death following possible ingestion of toad eggs. Toxicon 5(2):141–142.

———, and B. Low. 1968. Cardiac response of snakes after ingestion of toad parotoid venom. Copeia 1968(3):547–551.

Linnaeus, Carolus. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species cum characteribus, differentiis, synonymis, locis. 10th ed. vol. 1. L. Salvius, Stockholm. iv + 826 p.

Loftus-Hills, J. J., and B. M. Johnstone. 1969. Auditory function, communication, and the brain-evoked response in anuran amphibians. J. Acoust. Soc. Amer. 47:1131–1138.

Low, Bobbi S. 1972. Evidence from parotoid-gland secretions, p. 244–264. *In* W. Frank Blair (ed.), Evolution in the Genus *Bufo*. Univ. Texas Press, Austin. viii + 459 p.

Luque, O. de, A. S. Hunter, and F. R. Hunter. 1961. Osmotic studies of amphibian eggs. III. Ovulated eggs. Biol. Bull. (Woods Hole) 121:497–506.

Lutz, A. 1934. Notas sobre especies brasileiras do genero *Bufo*. Mem. Inst. Oswaldo Cruz 28:111–133.

Lutz, Bertha, and G. L. Kloss. 1952. Amfibios anuros do alto Solimoes e Rio Negro. Apontamentos sobre algumas formas e suas vicariantes. Mem. Inst. Oswaldo Cruz 50:625–678.

Machin, J. 1969. Passive water movements through skin of the toad *Bufo marinus* in air and in water. Amer. J. Physiol. 216(6):1562–1568.

Marinkelle, C. J. 1970. Observaciones sobre la periodicidad de las microfilarias de *Ochoterenella* en *Bufo marinus* de Colombia. Rev. Biol. Trop. (1968) 16(2):145–152.

———, and N. J. Willems. 1964. The toad, *Bufo marinus*, as a potential mechanical vector of eggs of *Ascaris lumbricoides*. J. Parasitol. 50:427–428.

Martin del Campo, Rafael. 1934. El organo de Bidder en *Bufo marinus*. An. Instit. Biol. Univ. Nac. Auton. Mexico 5:49–54.

Martinez-Albelo, L. E., and E. M. Liburd. 1963. Blood sugar studies in the toad *Bufo marinus*. Caribbean J. Sci. 3:129–131.

Melin, D. 1941. Contribution to the knowledge of the Amphibia of South America. Kungl. Vetenskaps-och Vitterhets-Samhalles Handlingar Sjatte Foljden. Ser. B. 1(4):1–71.

Merrem, Blasius. 1820. Tentamen systematis amphiborum (Ver-

such eines Systems der Amphibien). Johann Cristian Krieger, Marburg. xv + 191 p.

Nicoll, C. S., and P. Licht. 1971. Evolutionary biology of prolactins and somatotropins. II. Electrophoretic comparison of tetrapod somatotropins. Gen. Comp. Endocrinol. 17:490–507.

Osuch, M. V., and C. Chen. 1969. Fate of exogenous marinobufagin- ^{3}H in *Bufo marinus*. Biochem. Pharmacol. 18:1803–1808.

Pemberton, C. E. 1934. Local investigations on the introduced tropical American toad *Bufo marinus*. Hawaiian Planters Rec. 38(3):186–192.

——— 1949. Longevity of the tropical American toad, *Bufo marinus* L. Science 110:512.

Peneyra, R. S., and I. C. Masanga. 1966. Observations on the pathologic effects of experimental toad poisoning in dogs. Philippine J. Vet. Med. 5:70–78.

Rand, A. Stanley, and P. J. Rand. 1966. The relation of size and distance jumped in *Bufo marinus*. Herpetologia 22(3):206–209.

Reed, C. A., and R. Borowsky. 1966. The "world's largest toad" and other herpetological specimens from southern Suriname. Stud. Fauna Suriname Guyanas 12(50):159–171.

Rossi, J. V. 1983. The use of olfactory cues by *Bufo marinus*. J. Herpetol. 17(1):72–73.

Roth, J. J. 1973. Vascular supply to the ventral pelvic region of anurans as related to water balance. J. Morphol. 140(4):443–460.

Ruthven, Alexander G. 1919. The amphibians of the University of Michigan-Walker Expedition to British Guiana. Occas. Pap. Mus. Zool. Univ. Michigan 69:1–14.

Sabath, Michael D. 1981. Geographical patterns of genetic variability in introduced Australian populations of the marine toad, *Bufo marinus*: sorbitol dehydrogenase, *Sdh*. Biochem. Genet. 19(3–4):347–353.

———, W. C. Boughton, and S. Easteal. 1981. Expansion of the range of the introduced toad *Bufo marinus* in Australia from 1935 to 1974. Copeia 1981(3):676–680.

Saxena, P. K., and S. R. Lal. 1981. Seasonal changes in testes and thumb pads of the toad, *Bufo marinus* (Linn.) and their correlation with fluctuations in the environmental factors. Anat. Anz. 149:337–344.

Schmid, M. 1978. Chromosome banding in Amphibia 1. Constitutive heterochromatin and nucleolus organizer regions in *Bufo* and *Hyla*. Chromosoma 66:361–388.

Schmidt, Karl P. 1932. Reptiles and amphibians of the Mandel Venezuelan Expedition. Field Mus. Natur. Hist., Zool. Ser. 18(7):159–163.

Schneider, Johann G. 1799. Historiae amphibiarum naturalis et literariae. Fasc. 1. Fromann, Jena. xii + 266 p.

Seba, Albert. 1734. Locupletissimi rerum naturalium thesauri accurata descriptio, et iconibus artificiossimis expressio, per universam physices historiam. Vol. 1. Janssonio-Waesbergios et al., Amsterdam.

Sein, F. 1937. The development of the giant Surinam toad, *Bufo marinus* L. J. Agric. Univ. Puerto Rico 21(1):77–78.

Shannon, Frederick A., and J. E. Werler. 1955. Notes on amphibians of the Los Tuxtlas range of Veracruz, Mexico. Trans. Kansas Acad. Sci. 58(3):360–386.

Sherman, E. 1980. Cardiovascular responses of the toad *Bufo marinus* to thermal stress and water deprivation. Comp. Biochem. Physiol. 66A:643–650.

Shoemaker, V. H., and H. Waring. 1968. Effect of hypothalamic lesions on the water-balance response of a toad (*Bufo marinus*). Comp. Biochem. Physiol. 24(1):47–54.

Smith, Hobart M., T. Schneider, and R. B. Smith. 1977. An overlooked synonym of the giant toad *Bufo marinus* (Linnaeus) (Amphibia, Anura, Bufonidae). J. Herpetol. 11:423–425.

Spix, Johann Baptist von. 1824. Animalia nova, sive species novae Testudinum et Ranarum quas in itinere per Brasiliam, annis 1817–20. Monaco. 24 p.

Straughan, Ian R. 1966. The natural history of the "cane toad" in Queensland. Australian Mus. Mag. 15:230–232.

Straus, N. A. 1971. Comparative DNA renaturation kinetics in amphibians. Proc. Nat. Acad. Sci. U.S.A. 68:799–802.

Stuart, Laurence C. 1935. A contribution to a knowledge of the herpetology of a portion of the savanna region of central Peten, Guatemala. Misc. Publ. Mus. Zool. Univ. Mich. (29): 1–56.

——— 1951. The distributional implications of temperature tolerances and hemoglobin values in the toads *Bufo marinus* (Linnaeus) and *Bufo bocourti* Brocchi. Copeia 1951(3):220–229.

Taylor, Edward H. 1952a. Third contribution to the herpetology of San Luis Potosi. Univ. Kansas Sci. Bull. 34(13):793–815.

——— 1952b. A review of the frogs and toads of Costa Rica. Ibid. 35(5):577–942.

———, and Hobart M. Smith. 1945. Summary of the collections of amphibians made in México under the Walter Rathbone Bacon Traveling Scholarship. Proc. U.S. Nat. Mus. 95(3185): 521–613.

Tenney, S. M., and T. B. Tenney. 1970. Quantitative morphology of cold-blooded lungs: Amphibia and Reptilia. Resp. Physiol. 9:197–215.

Thorson, Thomas B. 1964. The partitioning of body water in Amphibia. Physiol. Zool. 37(4):395–399.

Tschudi, J. J. 1845. Reptilium conspectus quae in Republica Peruana reperiunter et pleraque observata vel collecta sunt in itinere. Arch. Naturges. 11(1):150–170.

Tyler, M. J. 1976. Frogs. Collins, Sydney. 256 p.

Valerio, C. E. 1971. Ability of some tropical tadpoles to survive without water. Copeia 1971(2):364–375.

Volkenberg, H. L. von. 1935. Biological control of an insect pest by a toad. Science 82:278–279.

Volpe, E. Peter, and B. M. Gebhardt. 1968. Somatic chromosomes of the marine toad, *Bufo marinus* (Linne). Copeia 1968(3):570–576.

Wallbaum, J. J. 1784. Beschreibung eines Meerfrosches. Schriften Ges. Naturf. Fr. Berlin 5:230–245.

Warburg, M. R. 1965. Studies on the water economy of some Australian frogs. Australian J. Zool. 13:317–330.

Werner, Franz. 1899. Ueber Reptilien und Batrachier aus Colombien und Trinidad. Verh. K.K. zool.-bot. Ges. Wien 49(9): 470–484.

Wiegmann, Arend Friedrich August. 1833. Herpetologische Beitrage. Isis von Oken 26(7):651–662.

Williams, J. T., Jr. 1967. A test for dominance of cues during maze learning by toads. Psychon. Sci. 9(5):259–260.

Wilson, Richard L. 1968. Systematics and faunal analysis of a Lower Pliocene vertebrate assemblage from Trego County, Kansas. Contrib. Mus. Paleo. Univ. Michigan 22:75–126.

Wolcott, G. N. 1937. What the giant Surinam toad, *Bufo marinus* L., is eating now in Puerto Rico. J. Agric. Univ. Puerto Rico 21(1):79–84.

——— 1950. The rise and fall of the white grub in Puerto Rico. Amer. Natur. 84:183–193.

Zipser, R. D., P. Licht, and H. A. Bern. 1969. Comparative effects of mammalian prolactin and growth hormone on growth in the toads *Bufo boreas* and *Bufo marinus*. Gen. Comp. Endocrinol. 13:382–391.

Zug, George. 1983. *Bufo marinus* (Sapo Grande, Sapo, Giant Toad, Marine Toad), p. 386–387. *In* D. Jansen (ed.), Costa Rican Natural History. Univ. Chicago Press.

———, E. Lindgren, and J. R. Pippett. 1975. Distribution and ecology of the marine toad, *Bufo marinus*, in Papua New Guinea. Pacific Sci. 29(1):31–50.

———, and P. B. Zug. 1979. The marine toad, *Bufo marinus*: a natural history resume of native populations. Smithson. Contrib. Zool. (284):1–58.

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